

4.0 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

As discussed in detail in Section 2.0, contamination at the Morning Star Mine comes from two basic sources. One source is the ore body itself; the composition of the ore body and host rock contains a suite of minerals associated with the geologic forces that created the Mojave. Gold and silver were identified as the value-bearing minerals in the ore body. The remainder of the host rock was identified as waste. Surface water samples (Table 3.1) and soil samples (Table 3.2) are discussed in Section 4.3.

The second potential source of contamination at the Morning Star Mine is the chemicals used in processing the ore, most notably, cyanide. The use of cyanide is discussed in Section 2.2.3. The remainder of the bioavailable Total and WAD cyanide used in the process circuit to separate gold and silver from the ore is still present in the heap leach pads and process solution. Total and WAD cyanide levels exceeded regulatory discharge limits in both the aqueous portion (Table 3.1) and soil portion (Table 3.2) of the heap leach pads. Cyanide can be extremely toxic when ingested in solution or inhaled as hydrogen cyanide gas and can cause death within minutes. Sprinkled over the leach pads in the form of a dilute solution during operations, cyanide remains present in:

- the void spaces in both of the heaps;
- the leak detection system and in the leachate collection system draining into the pregnant solution pond;
- the leak detection system and the leachate collection system in Pad No.2; and
- standing water around the perimeter of Pad No.2.

Another potential source of contamination was petroleum products that were stored, spilled or leaked from tanks, as well as industrial chemicals not stored on containment during the operation. Evaluation and analysis of potential petroleum contamination was outside of the scope of this document. However, the characterization of contents and removal of fifteen drums discovered during construction of the Interim Measures is discussed in Section 9. The source and extent of other potential contamination is discussed in Sections 2.1 and 2.2.

4.1 Locations of Hazardous Substances, Pollutants, or Contaminants

Section 2.3.1 discusses the location and dimensions of process facilities at the mine site. These facilities include the pregnant solution pond and two heap leach pads. Recent sampling of these mine features indicates the presence of both Total and WAD cyanide levels exceeding waste discharge limits established by the LRWQCB (Tables 3.1 and 3.2). Background soil samples were collected from offsite areas down gradient from the PSP and pads to fill data gaps, but no data exists to determine whether hazardous substances are present in soils near to and below the pregnant solution pond or the two heap leach pads. Little data exists that characterizes or examines groundwater beneath and down gradient of these features. No water has been detected in quantities enough to sample from the shallow monitoring wells beneath the PSP and heap pads.

4.2 Quantity, Volume, Size or Magnitude of Contamination

The focus of this EE/CA is to address the aqueous and solid heap leach pad material, the pregnant solution pond and the inventory of leachate contained in the system. Pad No.1 is roughly 12.5 acres in size and contains about 900,110 cubic yards of material (including berms). Pad No.2 is approximately 10.8 acres in size and contains nearly 450,250 cubic yards of material (including berms). Water analyses of samples collected from both of the pads reveal the presence of cyanide at concentrations above regulatory levels. In addition to the soil, there are an estimated seven to eight million gallons of dilute cyanide solution at the site stored in the pads and PSP.

4.3 Physical and Chemical Attributes of the Hazardous Substances

4.3.1 Surface Water

Water samples were collected from the mine pit, Pad No. 1 discharge, pregnant solution pond (PSP) and PSP leak detection system, Pad No.2 leachate collection (sump) and leak detection systems and the pooled water at the overflow point on Pad No. 2. Water sample analyses indicated levels of Total Cyanide above the California MCL discharge limit (0.20 mg/l) from Pad No.1, the PSP, the leak detection system at Pad No.2, and standing water at both sites on the perimeter of Pad No.2. With the exception of the leak collection system at Pad No.2, these sites also exceeded the LRWQCB discharge limits (Total Cyanide 1.0 mg/l, WAD Cyanide 0.2 mg/l).

2000-2002 Water Sample Analysis Exceedances of California MCLs

Location	CN	WAD CN	Cd	Co ¹	Mo ¹
Mine Pit	-	-	-	-	-
Pad No. 1 Discharge	yes	yes	-	-	
PSP	yes	yes	-	yes	yes
PSP Leak Detection	-	-	-	yes	yes
Pad No. 2 Collection System	-	-	yes	-	-
Pad No. 2 Leak Detection	yes ²	-	yes	-	yes
Pad No. 2 Standing Water	yes	yes	-	yes	yes

¹ No CA MCL. Exceeds USEPA Region 9 Tap Water PRG.

² Pad No. 2 Leak Detection results were above LRWQCB Waste Discharge Requirements for the site.

The Total Cyanide, WAD Cyanide, Cadmium (Cd), Cobalt (Co), and Molybdenum (Mo) were consistent with previous sampling results. Only one Selenium and one Thallium concentration were detected (both below regulatory limits), which was inconsistent with previous sampling results.

4.3.2 Mine Soils

Soil samples were collected from Pad No. 1, several locations on Pad No. 2, the waste rock dump and from areas down gradient from Pad No.1 and the waste rock piles (Fig. 3). Detections of cyanide were recorded from two sites on Pad No. 2.

2000-2002 Soil Sample Analysis Exceedances of LRWQCB WDRs and California TTCLs

Location	CN	WAD CN	Pb ¹
Top of Pad No. 2	yes	yes	-
At Leak Area, Pad No. 2	yes	yes	yes

¹ One other soil sample detected lead and another detected lead and thallium in concentrations that exceeded the USEPA Region 9 Residential PRGs, but not the California TTCLs.

There are no established LRWQCB MCLs for metals, so California Total Threshold Limit Concentrations (TTCLs) were used. The only constituent present in soil above these limits was lead (Pb), which was present above the TTCL at the leak area on Pad No.2.

4.3.3 Groundwater

Groundwater levels were consistent with previous findings (Table 3.3). Both water supply wells had water present and all five of the monitoring wells continued to be dry. A trace of water was detected in MW-1 at the PSP during May 2001, but was believed to be water trapped below the screened interval. There was not enough quantity to sample. No determination could be made as to whether the water occurred as the result of a wet spring or was pond leakage.

4.4 Targets Potentially Affected by the Site

Sampling data to identify the chemicals of concern supported identification of targets potentially affected by the site. This established a baseline to provide an estimate of how and to what extent human health and ecological receptors might be exposed to these chemicals and the potential risk of health problems if no cleanup action is taken at the site.

The potential primary release mechanisms for chemicals of potential concern (COPCs) at the site are infiltration/leaching to surface and subsurface soils, and surface water runoff to surface water bodies. Potential secondary release mechanisms are leaching of subsurface soils to groundwater, deposition of airborne dust from soils, and volatilization from surface water. The potential risk to human health from ingestion of surface soils, dermal contact with surface soils, inhalation of airborne particulates from surface soils, and inhalation of volatiles in ambient air from surface water are evaluated in Section 6.0. The risk assessment concluded that due to the remoteness of the mine, aridity of the site, and absence of operational facilities, few potential human receptors would visit the site. Due to the short expected exposure duration for those receptors likely to present on the site, adverse human health effects are unlikely.